*2020 IEEE International Conference for Innovation in Technology (INOCON)*
*Bengaluru, India. Nov 6-8, 2020*

# Raspberry Pi Based Smart Wearable Device for Women Safety using GPS and GSM Technology

Dhiraj Sunehra, SMIEEE[1], V. Sai Sreshta[2], V. Shashank[3], B. Uday Kumar Goud[4]
Department of ECE, JNTUH College of Engineering,
Jagtial, India
[1]dhirajsunehra@yahoo.co.in,[2]vuresaisreshta@gmail.com,[3]vodelashashank1@gmail.com,[4]uday.badhagowni.005@gmail.com

*Abstract*—**Security has become a major concern for women, children and even elders in every walk of their life. Women are getting assaulted and molested, children are getting kidnapped, elder citizens are also facing many problems like robbery, etc. In this paper, a smart security solution called smart wearable device system is implemented using the Raspberry Pi3 for enhancing the safety and security of women/children. It works as an alert as well as a security system. It provides a buzzer alert alert to the people who are nearby to the user (wearing the smart device). The system uses Global Positioning System (GPS) to locate the user, sends the location of the user through SMS to the emergency contact and police using the Global System for Mobile Communications (GSM) / General Radio Packet Service (GPRS) technology. The device also captures the image of the assault and surroundings of the user or victim using USB Web Camera interfaced to the device and sends it as an E-mail alert to the emergency contact soon after the user presses the panic button present on Smart wearable device system.**

***Keywords—Raspberry Pi3, IoT, GPS, GSM, E-mail alert***

## I. INTRODUCTION

The present generation is striving for equal rights, where men, women and every person is getting equal rights, responsibilities and work load is shared equally too. With this, the working schedule for women are also changing and they are being allocated with different working shifts, in the daytime or even in the nighttime. So, improving the security of women and children is very important, especially during the night times. Women may have to use various available means of transport to reach their offices or home during late night. The smart wearable device system presented here consists of a push button switch used as a panic button. Whenever the person wearing the device gets into trouble, he or she pushes the button. Soon after pushing the panic button, GPS module interfaced with the system locates the user and sends the location of the user (person wearing the device) to the emergency contact and police using the GSM module. The USB camera captures the image of the surroundings of the user and Pi sends an E-mail with the captured image and alert message to the emergency contact.

## II. LITERATURE REVIEW

Ruman et al developed a safety assistant for women using Arduino to locate the victim, alerting the concerned person and the police and also generating an electrical shock for defense [1]. Sharma et al used Raspberry Pi to design a smart shoe which is used as a tracker for women, children and also elders provided with the GPS module and also as self- defense mechanism using buzzer [2]. Abhipriya et al implemented a reliable system which protects the victim even during the least connectivity times using radio identification based cognitive radio, GSM and GPS and sends a location URL to respective authorities [3]. Otterson and Dufner described a security system which sends the location of the victim using GPS and GSM and also the captured image of the victim and also the assault using a camera fixed in the system to the respected people [4]. Chitrakara et al developed a special gadget especially for girls and women who face problems like domestic violence, sexual assaults etc., which makes the women win against the oppressor [5].

## III. HARDWARE DESCRIPTION

Figure 1 shows the block diagram of the smart wearable device system consisting of Raspberry Pi 3 Model B+ board, GPS module, GSM module for SMS alert, USB camera, buzzer, and a push button switch used as a panic button.

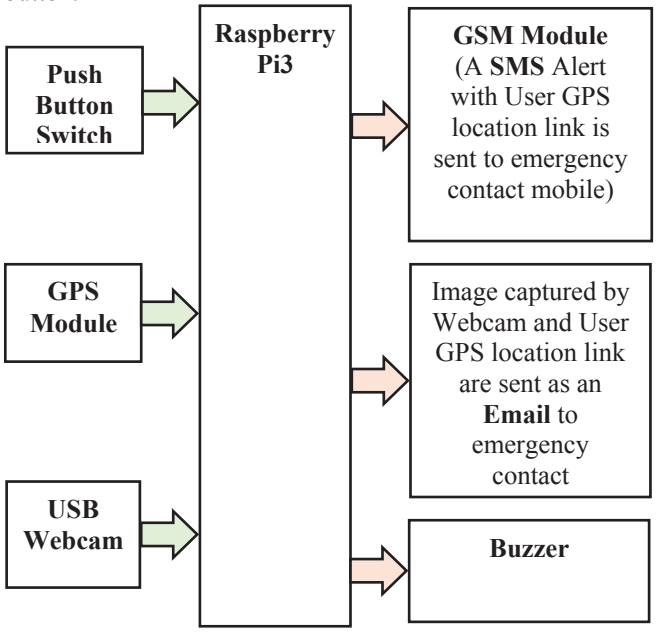


Fig. 1. Block Diagram of Smart Wearable Device System

### A. Salient Features of Raspberry Pi3 Model B+

Raspberry Pi is a mini card sized computer that can be connected to your TV, or computer and is capable of doing what a mini computer can do. It has a Broadcom BCM2837 Quad Core Processor running at 1.3GHz with 1GB SDRAM and 4 USB 2.0 ports (Fig. 2). There is no inbuilt storage in Raspberry Pi. The operating system for the Raspberry Pi is loaded into the SD card whose storage can range from 8GB to 64GB. It has 40 pins, out of which 26 are GPIO pins

**978-1-7281-9744-9/20/$31.00 ©2020 IEEE**

including UART, four PWM channels, I2C bus, SPI bus, 5V and GND. It has a BCM43143 Wi-Fi onboard and Bluetooth Low Energy (BLE) onboard and also has a Camera Serial Interface port to connect Pi camera through which we can take HD videos and still photographs [6].

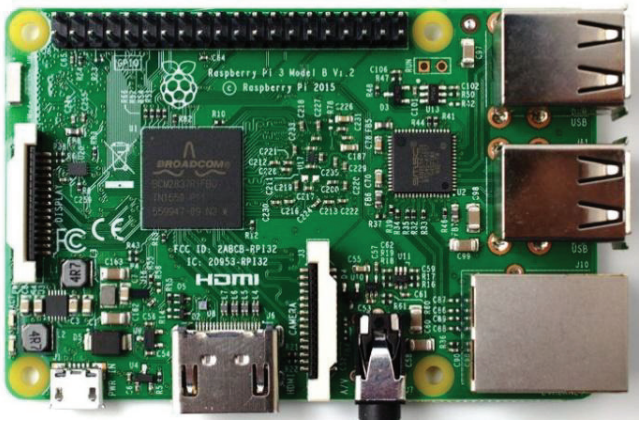

Fig. 2. Raspberry Pi3 Model B+ Board

### B. *User Location estimation using GPS Module*

Global Positioning System (GPS) is a satellite-based navigation system consisting of 24 satellites and is developed by the U.S. Department of Defense. A GPS receiver computes the user location in three dimensions, viz. latitude, longitude and height by using the signals from minimum of four satellites. Each satellite transmits two PRN codes (Pseudo Random Noise Code), viz. Coarse Acquisition (C/A) code and Precision (P) code along with navigation data which comprises of the satellite ephemeris. The PRN codes are used to obtain the range or distance between the satellite and the receiver. The ephemeris data are used to compute the satellite position. By using the signals from four satellites and the corresponding ranges (pseudorange), a GPS receiver estimates the four unknowns, i.e. user position (x, y, z) and the satellite receiver clock offset. The GPS signals are transmitted on two L-band frequencies L1(1575.42 MHz) and L2(1227.60 MHz) [7]. Figure 3 shows the commercially available GPS module.

The commercially available GPS module provides raw GPS data which can be converted to the desired format after post-processing. The portable GPS receivers generate GPS data in National Marine Electronics Association (NMEA) format. Each NMEA sentence is prefixed with a $ symbol, a 4-5 letter code that signifies the information contained within the sentence and comma separates each value. The NMEA data format provides various output messages. One of the commonly used NMEA sentence is the "GPRMC" which provides the GPS position, velocity, and time information. The user position is represented in the World Geodetic System 1984 (WGS84).

A sample $GPRMC sentence is as follows:

$GPRMC,114016,A,1722.862,N,7828.027,E,026.8,085.5,230215,003.4,W*6A

The description of various fields in the above GPRMC sentence can be found elsewhere [8]. From the NMEA data, the following two parameters are extracted by the Raspberry Pi:

1722.798,N : Latitude 17 deg 22.862' N

7828.027,E : Longitude 78 deg 28.027' E

Fig. 3. GPS Receiver Module

### C. *Features of GSM Module*

Global System for Mobile Communications (GSM) is a standard used for 2G cellular networks. The SIM 900A mobile communication modem is used here. A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. It uses Time Division Multiple Access (TDMA) technique for communication purpose. It will have a SIM slot where the SIM card is inserted and by using AT commands, SMS messages can be sent to the registered mobile number. It operates on a supply voltage of 9-12 V DC. Figure 4 shows the GSM Module [9].

Fig. 4. SIM900A GSM Module

### D. *USB Web Camera*

USB Web camera is used to capture image, videos and also for live streaming. It can be connected to the device used by the USB port. It allows data rate up to 400 Mbytes per second and consumes less than 1 W of power through USB. A webcam usually consists of a lens, an image sensor and electronic circuitry, may also include one or two microphones. Figure 5 shows the USB Web camera.


Fig. 5. USB Web Camera

### E. *Buzzer*

A buzzer is an audio signaling device which may be mechanical, electromechanical or piezoelectric. It converts electrical energy into sound. When power is applied to the buzzer it causes the ceramic disk to contract or expand, thus it causes the surrounding disc to vibrate and that is the sound that we hear. Figure 6 shows the buzzer.

Fig. 6. Buzzer

## IV. SOFTWARE TOOLS

### A. *PuTTY Software*

PuTTY is a free and open source terminal emulator including SCP, SSH and rlogin network protocols. It is a versatile tool for remote access to another computer. We can use it to emulate another operating system or for secure data transfer even over public domain [10]. It's used more often by people who want secure remote shell access to Unix or Linux system. Figure 7 shows the PuTTY configuration.

Python is developed by Guido van Rossum at the National Research Institute for Mathematics and Computer Science in the Netherlands. It is a high-level, interpreted, interactive and object-oriented scripting language [11]. Python is highly readable and has fewer syntactical constructions than other languages. It supports multiple programming paradigms including structured, object oriented and functional programming. Interpreted means that we don't need to compile the program before executing it. It has many predefined libraries due to which programming in python becomes an easy task. It supports Unix, Linux and Windows based operating systems. Python can run on wide number of hardware platforms and supports GUI applications as well. These GUI applications can be ported to many system calls, libraries, etc. It provides better support for large programs as compared to shell scripting.

### B. *Python Language*

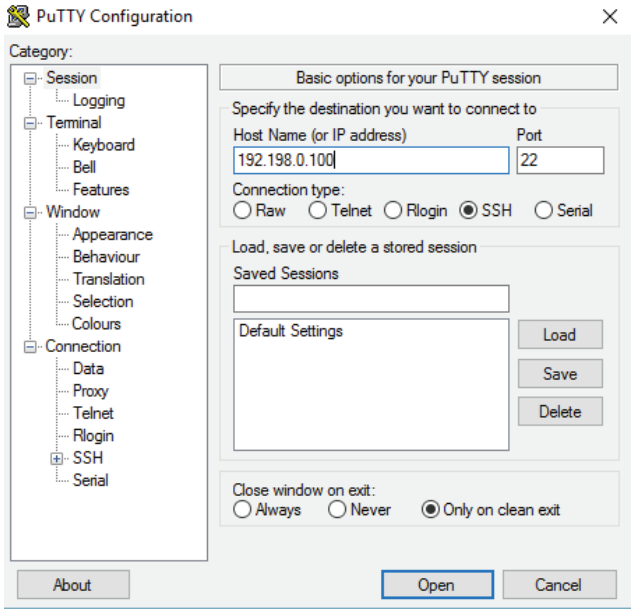


Fig. 7. PuTTY Configuration

## V. SCHEMATIC DIAGRAM AND FLOWCHART

The schematic diagram of the smart wearable device system is shown in Fig. 8. It shows the interfacing of various components like GPS, GSM, USB camera, buzzer to the Raspberry Pi board. This schematic is prepared using Fritzing software by importing components from Adafruit library.

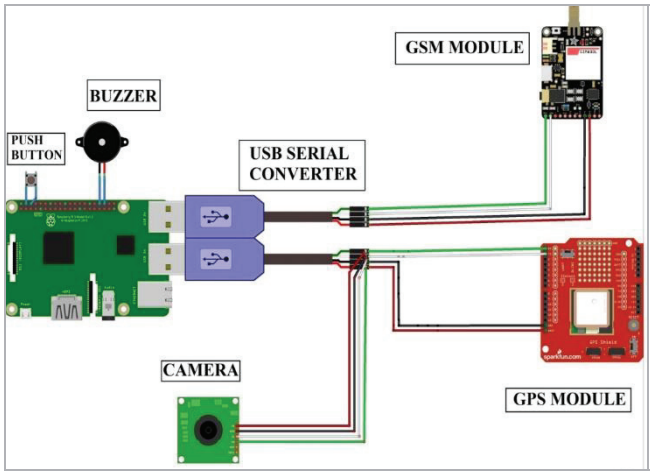


Fig. 8. Schematic Diagram

The flowchart of the smart wearable device system describes the flow of operations that take place in the system. When the system is powered on, the Raspberry Pi, GPS and GSM modules are initialized. When the user finds a trouble, push button will be pressed by him. As soon as the panic button is pressed, GPS location is read by the Pi, the user location link is sent to the emergency contact and police using the GSM module. Also, the USB web camera captures the image of the victim, assault and the surroundings and sends the images as an email to the respective authorities, along with the location link which can be opened in Google maps. This alert and security system can thus help in saving the victim. The buzzer also gets on, thereby alerting the surrounding people too. Figure 9 shows the flowchart of the system.

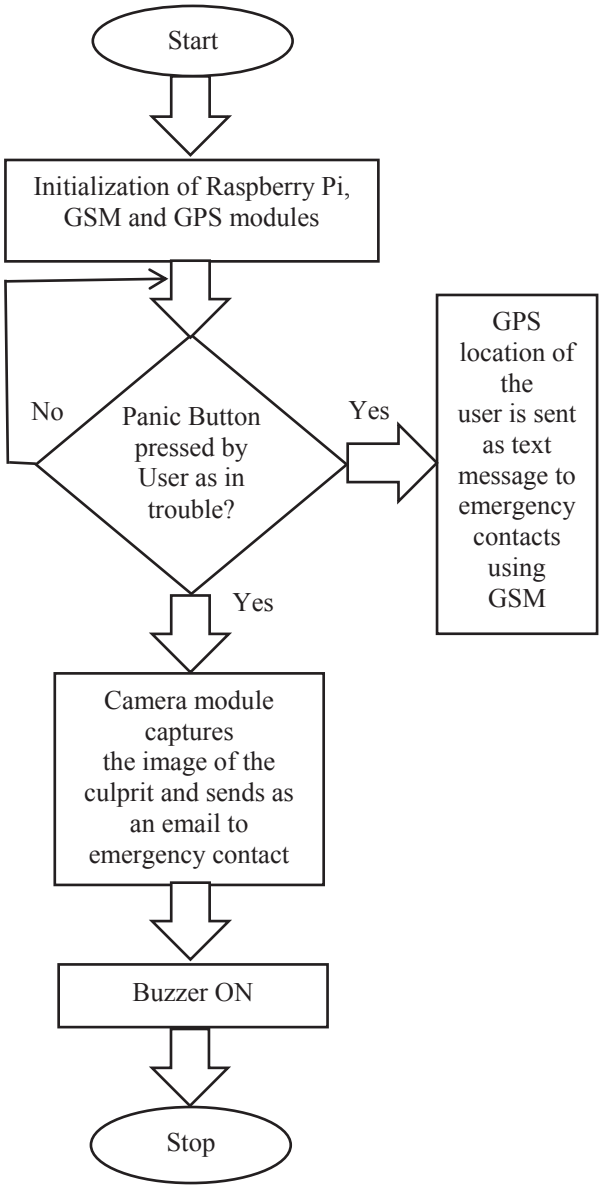


Fig. 9. Flowchart showing sequence of operations that take place in the Smart Wearable Device system

## VI. Experimental Setup

Figure 1 shows the experimental setup of the system.

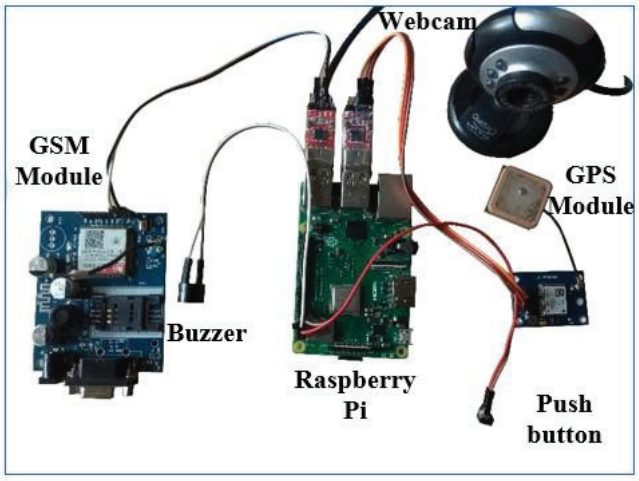


Fig. 10. Experimental Setup

## VII. Results and Discussion

Figure 11 shows the snapshot of the SMS alert with Google map location link received in the mobile of the emergency contact. By clicking the link, the care taker or police can know the exact location of the victim and reach the place or inform the nearest police station to protect the victim.

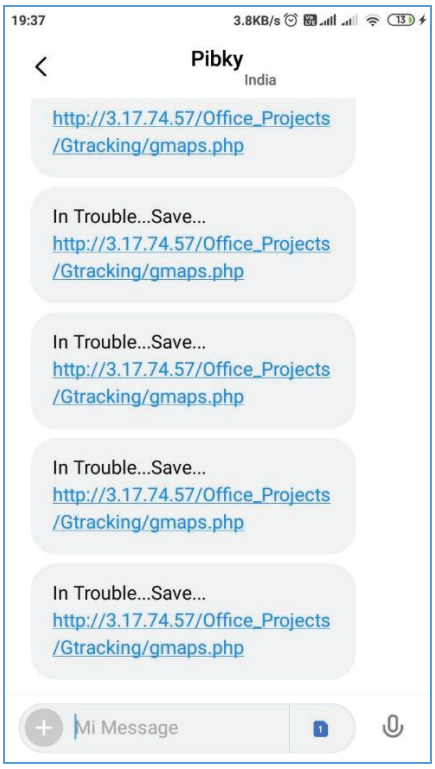


Fig. 11. SMS alert with User GPS location (Google map) link sent to the mobile of the emergency contact

Figure 12 shows the snapshot of the Google map location of the victim (user).

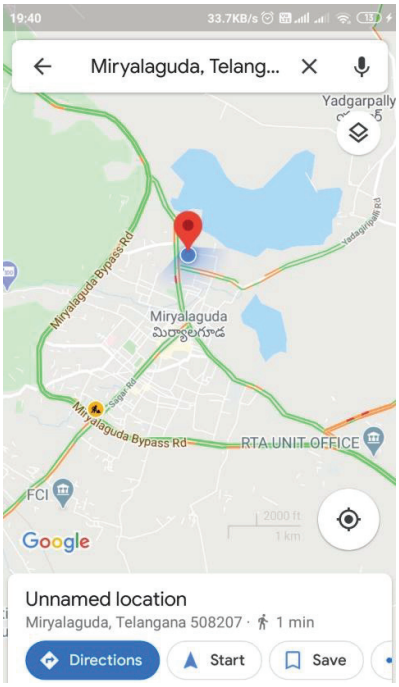


Fig. 12. User Location Tracked on Google maps

Figure 13 shows the snapshot of the email alert sent to the emergency contact along with the captured image of the surrounding area where the user (victim) is located.

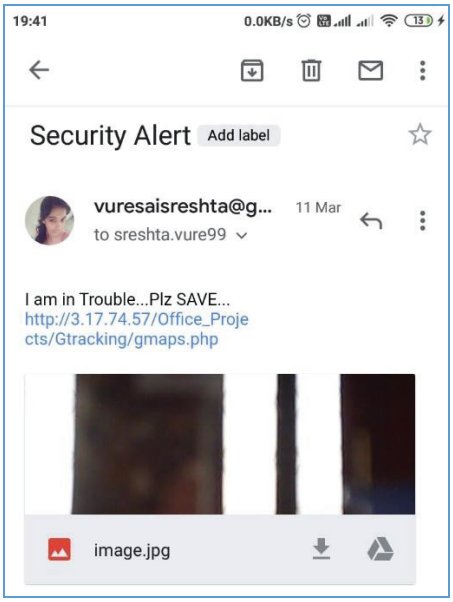


Fig. 13. Email alert with User location (Google map) link sent to email of the emergency contact along with captured image of the surrounding area

Figure 14 shows the captured image by webcam of the surrounding area where the user (victim) is located.

Fig. 14. Image captured by the Webcam when the user presses the panic button

## VIII. Conclusions

In this paper, a Raspberry Pi based smart wearable device system for Women safety is implemented using GPS and GSM technology. The system provides safety and security not only for women, but also for other people (especially elderly persons and children) in every walk of their life. The advantage of using Raspberry Pi3 Model B+ is that it has an in-built Wi-Fi module that can connect to the internet, without use of an external router. It can thus send an email alert to the predefined contact. The system can be made portable by fixing all the components inside a small enclosure and making it battery operated.

## References


[1] M. R. Ruman, J. K. Badhon and S. Saha, "Safety Assistant And Harassment Prevention For Women," 5th International Conference on Advances in Electrical Engineering (ICAEE), Dhaka, Bangladesh, 2019, pp. 346-350.

[2] V. Sharma, Y. Tomar and D. Vydeki, "Smart Shoe for Women Safety," IEEE 10th International Conference on Awareness Science and Technology (ICAST), Morioka, Japan, 2019, pp. 1-4.

[3] R. Abhipriya, S. Aysha, K. Gayathri and K. Kathiravan, "3S: A radio identification based continuous spectrum sensing protocol for safety of women in cognitive radio networks," International Conference on Communication and Signal Processing (ICCSP), Chennai, 2017, pp. 2042-2046.

[4] D. Chitkara, N. Sachdeva and Y. Dev Vashisht, "Design of a women safety device," IEEE Region 10 Humanitarian Technology Conference (R10-HTC), Agra, 2016, pp. 1-3.

[5] L. Otterson and D. Dufner, "Integrating technology into the mission of a women's center: creating a women's community with technology," International Symposium on Technology and Society - Women and Technology: Historical, Societal, and Professional Perspectives. Proceedings. Networking the World (Cat. No.99CH37005), New Brunswick, NJ, USA, 1999, pp. 393-398.

[6] https://www.raspberrypi.org/

[7] https://www.gps.gov/

[8] http://www.elgps.com/public_ftp/Documentos/SIRF_Protocol.pdf

[9] https://www.rhydolabz.com/

[10] https://putty.en.softonic.com/

[11] Richard L. Halterman, “Learning to Program with Python”, 2011 (www.cs.uky.edu/).